CATCHES AND CATCH RATES OF PELAGIC SHARKS FROM THE NORTHWESTERN ATLANTIC, GULF OF MEXICO, AND CARIBBEAN

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SUMMARY

U.S. commercial and recreational landings and discard estimates of pelagic sharks were compiled from several sources. Commercial landings were obtained from northeast and southeast regional general canvass data, and quota monitoring data of permitted shark dealer reports in the U.S. southeastern region. Recreational harvest estimates were obtained from three recreational surveys. Dead discards of pelagic sharks in the U.S. longline fleet targeting tunas and tuna-like species, which have been reported to ICCAT previously, were estimated based on mandatory logbook and observer records from this fishery. Estimates of pelagic sharks caught as bycatch but landed were based on weighout sheets from the landed catch of U.S. longline fishermen with permits to land and sell swordfish caught in the Atlantic. Updated catch rate information for pelagic sharks from the northwestern Atlantic, Gulf of Mexico, and Caribbean was also compiled and trends analyzed. Commercial time series were derived from both logbook and observer reports from the pelagic longline fleet, and recreational time series used data from the Large Pelagic Survey (LPS) for the eastern U.S. coast from Virginia to Massachusetts. Most time series examined were previously standardized by various authors through GLM procedures and were available for mako and thresher species, and blue, oceanic whitetip, and porbeagle sharks.

RÉSUMÉ

Les estimations des débarquements et des rejets, commerciaux et sportifs, de requins pélagiques ont été compilées d'après plusieurs sources. Les débarquements commerciaux proviennent des données d'enquêtes générales sur les régions nord-est et sud-est, et des données sur le suivi des quotas des registres des mareyeurs autorisés au sud-est des Etats-Unis. Les estimations de la pêche sportive proviennent de trois enquêtes sur cette pêche. Les rejets de requins pélagiques morts des palangriers américains qui visent le thon et les espèces voisines, qui ont déjà été transmis à l'ICCAT, ont été estimés d'après les carnets de pêche obligatoires et les rapports des observateurs de cette pêcherie. Les estimations des requins pélagiques capturés en tant que prise accessoire, mais débarqués, se fondaient sur les fiches de pesage de la prise débarquée des palangriers américains autorisés à décharger et à vendre l'espadon capturé dans l'Atlantique. Une information actualisée sur le taux de capture de requins pélagiques dans l'Atlantique nord-ouest, le golfe du Mexique et les Caraïbes a également été compilée, et sa tendance analysée. Les séries temporelles commerciales proviennent des livres de bord et des rapports d'observateurs de la flotte palangrière pélagique, et des séries temporelles sportives de la Large Pelagic Survey (LPS) sur la côte est des Etats-Unis, de la Virginie au Massachusetts. La plupart des séries temporelles examinées avaient d'abord été standardisées par divers auteurs au moyen de méthodes GLM, et étaient disponibles pour les requins-taupes et les requins-renards, le requin peau bleue, le Carcharhinus longimanus, et le requin-taupe commun.

RESUMEN

Las estimaciones de desembarques y de descartes de tiburones pelágicos de las pesquerías comerciales y de recreo de Estados Unidos se han extraído de varias fuentes. Los desembarques comerciales se obtuvieron de los datos sondes regionales realizados en el Nordeste y Sudeste y de los datos de seguimiento de cuota de las declaraciones de los mayoristas de tiburón con autorizados de la región sudeste de Estados Unidos. Las

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estimaciones de capturas de la pesquería de recreo se extrajeron de tres encuestas de pesca de recreo. Los descartes de tiburones pelágicos muertos de la flota de palangre de Estados Unidos dirigida a túnidos y especies afines, comunicados previamente a ICCAT, se estimaron mediante los registros de los observadores y los cuadernos de pesca obligatorios de esta pesquería. Las estimaciones de los tiburones pelágicos capturados fortuitamente pero desembarcados se basaron en las fichas de pesada de la captura desembarcada de palangreros estadounidenses con permiso para desembarcar y vender pez espada capturado en el Atlántico. También se compiló información actualizada sobre tasas de captura de tiburones pelágicos del Atlántico noroeste, Golfo de Méjico y mar Caribe, y se analizaron las tendencias observadas. Las series temporales de la pesquería comercial se extrajeron de los cuadernos de pesca y los informes de los observadores de la flota de palangre pelágico y las series temporales de la pesquería de recreo de los datos de la Large Pelagic Survey (LPS) de la costa este de Estados Unidos, desde Virginia a Massachusetts. La mayoría de las series temporales examinadas habían sido previamente estandarizadas por diferentes autores con procedimientos GLM y estaban disponibles para especies de Isurus spp y Alopias spp, tiburones azules, Carcharhinus longimanus y marrrajo sardinero.

1. INTRODUCTION

The U.S. Federal Fisheries Management Plan (FMP) implemented in 1993 (NMFS 1993) identified three management groups: large coastal sharks, small coastal sharks, and pelagic sharks. The pelagic complex included ten species: shortfin mako (*Isurus oxyrinchus*), longfin mako (*Isurus paucus*), porbeagle (*Lamna nasus*), thresher (*Alopias vulpinus*), bigeye thresher (*Alopias superciliosus*), blue (*Prionace glauca*), oceanic whitetip (*Carcharhinus longimanus*), sevengill (*Heptranchias perlo*), sixgill (*Hexanchus griseus*), and bigeye sixgill (*Hexanchus vitulus*). The 1993 FMP classified the status of pelagic sharks as unknown because no stock assessment had been conducted for this complex. The Maximum Sustainable Yield (MSY) for pelagic sharks was set at 1,560 mt dressed weight (dw), which was the 1986-1991 commercial landings average for this group. In 1997, as a result of indications that the abundance of Atlantic sharks had declined, commercial quotas for large coastal, small coastal, and pelagic sharks were reduced. The quota for pelagic sharks was set at 580 mt. More recently, the U.S. 1999 FMP for Atlantic Tunas, Swordfish, and Sharks (NMFS 1999) proposed the following measures affecting pelagic sharks: 1) a reduction in the recreational bag limit to 1 Atlantic shark per vessel per trip, with a minimum size of 137 cm fork length for all sharks, 2) an increase in the annual commercial quota for pelagic sharks to 853 mt dw, apportioned between porbeagle (92 mt), blue sharks (273 mt dw), and other pelagic sharks (488 mt dw), with the pelagic shark quota being reduced by any overharvest in the blue shark quota, and 3) making the bigeye sixgill, sixgill, sevengill, bigeye thresher, and longfin mako sharks prohibited species that cannot be retained. All these regulations were recently implemented.

Sharks included in the U.S. pelagic shark management unit are generally trans-oceanic species that are harvested or caught as bycatch in the North Atlantic Ocean by fishers from several nations. It is now clear that assessment of these pelagic shark resources will likely require a multinational approach. Estimates of catches and catch rates will thus be required to conduct stock assessments of these resources.

In this document estimates of U.S. commercial landings, recreational catches, and bycatch of pelagic sharks were compiled from a variety of sources for the period 1981-2000. Catch data are presented for pelagic sharks as a group and for blue shark, shortfin mako, thresher shark, longfin mako, oceanic whitetip shark, porbeagle, and bigeye thresher. Catch rate information from commercial and recreational sources for pelagic sharks from the U.S. east and Gulf of Mexico coasts

and Caribbean is also summarized and analyzed. Time series were available for blue shark, makos (*Isurus* spp.), threshers (*Alopias* spp.), oceanic whitetip shark, and porbeagle.

2. MATERIALS AND METHODS

2.1 Catches

U.S. commercial landings for 1982-2000 were based on weighout sheets from the landed catch of U.S. longline fishermen holding permits to land and sell swordfish caught in the Atlantic Ocean (Cramer 1996, Cramer and Bertolino 1999, Cramer et al. 1999, Cramer, unpublished data). These landings were reported as metric tons whole weight and in numbers. Whole weight was transformed to dressed weight by applying a conversion factor of 1.96. Landings for 1995-1999 were also available from the northeast and southeast regional general canvass data, and the Southeast Fisheries Science Center (SEFSC) quota monitoring data, based on southeastern region permitted shark dealer reports. These landings include those based on the weighout sheets for 1995-1999. Average weights based on lengths reported in the weighout sheets were available for 1986-1997 (1998-2000 data could not be accessed on time for this report). They were obtained by applying published length-weight relationships to each species of interest. If an average length was not available or the sample size was very low (n<5) for any given year, the mean for all remaining years (with n≥5) was applied to that year. Landings in numbers for 1995-1999 were obtained by dividing landings in lb dw by the average weight in lb dw for that year. No average weights were available from the weighout sheets for the bigeye thresher, thus weights estimated from lengths reported in the Pelagic Longline Observer Program operated by the SEFSC were used instead to obtain landings in numbers for 1995-1999.

Recreational harvest estimates were obtained from the U.S. Marine Recreational Fishery Statistics Program (MRFSS), the National Marine Fisheries Service (NMFS) Headboat Survey operated by the SEFSC Beaufort Laboratory, and the Texas Parks and Wildlife Recreational Fishing Survey (TXPWD). Combined, these surveys cover the recreational fisheries operating from Maine to Texas, from 1981 to 2000. Almost the totality of recreational catches came from the MRFSS survey. Catches are typically reported as numbers and yield estimates were obtained by multiplying catch in numbers by average weights calculated from lengths through published length-weight relationships. A conversion factor of 2.0 was used to transform whole weights into dressed weights. If an average length was not available or the sample size was very low (n<5) for any given year, the mean for all remaining years (with n≥5) was applied to that year.

Dead discards of pelagic sharks in fisheries targeting tuna and tuna-like species were compiled based on mandatory logbooks from longline and other vessels (Large Pelagic Logbook) and observer reports from these fisheries (SEFSC Pelagic Longline Observer Program) as reported in Cramer 1997, 2000a, Cramer and Adams 1998, Cramer et al. 1998, Cramer et al. 2000, and Cramer (unpublished data). The majority of vessels (90%) use longline gear (Cramer 1997). Discards are typically recorded in numbers and weight (mt ww), and were further expressed as dw by using a conversion factor of 1.96. Dead discard estimates were available starting in 1987.

2.2 Catch rates

Some indices of abundance presented previously (Cortés 2000) were updated and some new series included. The majority of the series presented were previously standardized for various effects, thought to influence catch rates but not related to abundance, through GLM procedures (Brown 2000, Cramer 2000b). The time series examined include several commercial and recreational sources. Commercial sources include: the Large Pelagic Logbook (LPL) based on mandatory reports from longline and bottom longline vessels, covering the period 1986-1999 (Cramer 2000b); trip weighout records from longline vessels, available for 1985-1993; observer reports from Japanese vessels that operated within the U.S. EEZ between 1978 and 1988; and observer reports from the SEFSC Pelagic Longline Observer Program (PLLOP) covering two statistical areas off the U.S. Atlantic coast (NMFS area 4 [South Atlantic Bight] and NMFS area 3 [Florida East Coast]) and the period 1992-2000

(Beerkircher et al. in press). Recreational data are from the Large Pelagic Survey (LPS), which collects catch rate information on rod and reel and handline fisheries off the coast of the eastern U.S. from Virginia trough Massachusetts, and were available for 1986-1998 (Brown 2000).

Each annual CPUE value was weighted by the inverse of the precision of the value (the coefficient of variation). Catch rate indices were then expressed on a relative scale by dividing each yearly GLM-standardized catch rate value by the mean value across years. This allowed comparison of various series on a common scale. The fourteen available series also were examined for evidence of trends by fitting simple linear regressions to the relative CPUE series, in some cases after log-transforming the dependent variable (CPUE values) to obtain a better fit.

To examine further trends in the data, a generalized linear model was also applied to the four time series available for blue shark and the five time series available for makos (*Isurus* spp.). This approach scales each independent catch rate trajectory into a single "combined" series representing an average for each species. The model was applied to log-transformed catch rates weighted by the inverse of the precision of each value, and used year and source of data (time series) as factors. The resulting CPUE series for blue shark and makos were expressed on a relative basis and a linear regression fit to them to detect trends.

3. RESULTS AND DISCUSSION

3.1 Catches

Commercial landings of pelagic sharks steadily increased from the early 1980s and peaked in 1995 and 1996 (Table 1; Fig. 1a) according to weighout sheets, and quota monitoring and general canvass program data. Mean average weights for pelagic sharks during 1986-1997, estimated from the weighout sheets, ranged from 57.6 to 85.9 lb dw (Table 1). Recreational landings in numbers estimated from the MRFSS survey during 1981-2000 fluctuated from a minimum of about 5,600 fish in 1994 to a maximum of 93,000 fish in 1985 (Table 1; Fig. 1a). Pelagic longline dead discards also fluctuated between 1987 and 2000, with a minimum of about 3,500 fish in 1999 and a maximum of about 30,500 fish in 1993. Total catches ranged from about 12,500 fish in 1981 (no commercial landings or discard estimates were available for that year) to about 95,000 fish in 1985, as a result of the peak in recreational landings that year.

Blue shark commercial landings were negligible (Table 2; Fig. 1b). Recreational landings in numbers ranged from about 500 fish in 1994 and 1995 to over 20,000 fish in 1987. Pelagic longline discards reached 29,000 fish in 1993, but otherwise oscillated between a minimum of about 3,000 fish in 1999 to a maximum of about 19,000 fish in 1996 (Table 2). The trends in recreational landings and dead discards were very similar from 1992 to 1997 (Fig. 1b). Total catches ranged from 0 fish in 1982 (a year in which no commercial or recreational landings were reported) to about 43,500 fish in 1993, the year in which dead discard estimates peaked (Table 2; Fig. 1b).

Shortfin mako commercial landings never exceeded 5,000 fish according to weighout sheets, and quota monitoring and general canvass program data (Table 3; Fig. 1c). Note that commercial landings from 1995 to 2000 in the quota monitoring and general canvass program data are also assigned to an unclassified "mako" category, in addition to the "shortfin mako" category considered here. Adding these landings of unclassified makos, which are likely to be shorfin makos, would increase commercial landings for this species, but would not affect significantly total catches. Most of the landings were attributable to the recreational fishery, whose landings in numbers peaked in 1985 (as for blue shark) to about 80,000 fish, and ranged from less than 1,500 fish to over 31,000 fish in the remaining years. Pelagic longline discards of shortfin makos were negligible. Total catches ranged from less than 4,000 fish in 1999 to almost 82,000 fish in 1985, when recreational catches peaked (Table 3; Fig. 1c).

Total catches of thresher sharks peaked at about 5,300 fish in 1984 and 1999 (Table 4). A maximum of about 1,200 and 1,300 fish were estimated to have been landed by the commercial fishery in 1995 and 1997, respectively, whereas recreational landings peaked at about 5,250 fish in 1984. The maximum estimate of dead discards from the pelagic longline fishery was about 700 fish in 1989.

Total catches of longfin makos in any given year were under 450 fish. Very few longfin makos were landed by the commercial fishery, there were no reported landings from recreational fisheries, and only some fish were reported discarded dead from 1992 to 1995 (Table 5). Very few oceanic whitetip sharks were landed by the commercial fishery, except for a peak of about 1,250 fish in 1983, but otherwise total catches never exceeded 450 fish (Table 6). Total reported catches of porbeagle, and especially bigeye thresher, were also very low (Tables 7 and 8).

3.2 Catch rates

The LPL catch rate series for blue shark shows a very rapid decline from the mid 80s to the late 80s, followed by a small recovery in 1990, a decreasing trend until 1995, followed again by a recovery the next year and subsequent decline (Fig. 2a). The LPS series shows a variable but generally increasing trend, with a peak in 1996, followed by a decrease in 1997 and a return to values from the early 1990s in 1998. The Japanese observer series shows declining trends for blue sharks from the late 70s to early 80s and from the mid to the late 80s, after which no more data were available. The PLLOP series shows a variable trend, with increasing tendencies from 1992 to 1995, and from 1996 to 1998, followed by a decrease to pre-1995 values in 2000.

Three of the five series available for makos (*Isurus* spp.) show a declining trend in catch rates from 1986 to 1988 (Fig. 2b). The LPL series shows a clearly decreasing trend overall from 1986 to 1999, with several oscillations in between and a stable trend from 1993 to 1997. The biomass series obtained from the weighout records initially increases from 1985 to 1988, decreases up to 1992, and is followed by a recovery in its final year, 1993. The LPS series is highly variable, with decreasing trends from 1986 to 1988, and from 1991 to 1995, and increases from 1988 to 1991, and from 1995 to 1998, with the latter year being the highest point of the series. The Japanese observer series seems to have stabilized somewhat after a rapid decrease in the late 70s and early 80s. The PLLOP series shows a decreasing trend overall, with a peak in 1992 and the lowest point in 1998.

Thresher shark (*Alopias* spp.) catch rates from the LPL series show a generally decreasing trend from 1987 to 1999, after an initial steep increase from 1986 to 1987 (Fig. 2c). The biomass series from the weighout records is highly variable, with two accentuated increases and one steep decrease. For the oceanic whitetip shark, the LPL series shows no clear pattern, whereas the PLLOP series shows a generally decreasing trend from 1992 (its peak) to 2000 (its nadir) (Fig. 3a). The only series available for the porbeagle was the LPL, which shows a highly variable trajectory (Fig. 3b).

Analysis of catch rate trends in the fourteen series examined (Table 9) revealed that nine had negative slopes, of which seven were significant (two significant at the 5% probability level, three at the 1% level, and two at the 0.1% level), and five had positives slopes, of which only one was significant (at the 1% level). Two out of the four series for blue shark exhibited significant negative slopes and one had a significantly positive slope. For makos, four of the five series exhibited negative slopes, three of which were significant, whereas the fifth series had a positive, but non-significant slope. One of the two series for both thresher sharks and oceanic whitetip sharks was significantly negative and the other was positive, but not significantly. The only series available for the porbeagle had a non-significant negative slope. The largest annual rates of decrease and increase from these indices corresponded to oceanic whitetip sharks (18% decrease in the PLLOP index) and to blue shark (17% increase in the LPS index), respectively.

The combined, GLM-standardized catch rate series for blue shark (Fig. 4a) and makos (Fig. 4b) both showed very high variability in the early years of the series, and thus do not allow one to detect

significant differences in catch rates between any two consecutive years. The blue shark series shows an initial decline from 1978 to 1982, followed by a recovery up to 1984 and a further decline up to 1987, after which the series seems to remain fairly stable (Fig. 4a). The series for makos shows a similar trend, with more oscillations, but also seems to remain fairly stable after 1987 (Fig. 4b). Both series had a highly significant negative slope (blue shark: slope = -0.0835, P = 0.0004; makos: slope = -0.0979, P = 0.0001).

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Table 1. Estimates of commercial and recreational landings and dead discards for pelagic sharks in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww) [1]	mt (dw) [2]	lb (dw) [3]	av. weight [4]	number [5]	number [6]	av. weight [7]	lb (dw)	number [8]	mt (ww) [8]	lb (dw) [9]	number	lb (dw)
1981						12,603	50.035	630,591				12,603	630,591
1982	45.41	23.17	51,077		1,354	20,015	50.996	1,020,685				21,369	1,071,762
1983	51.89	26.47	58,367		1,627	21,968	117.64	2,584,316				23,595	2,642,683
1984	49.12	25.06	55,250		1,538	23,295	67.489	1,572,156				24,833	1,627,406
1985	57.99	29.59	65,227		1,969	92,998	38.224	3,554,756				94,967	3,619,982
1986	68.50	34.95	77,049	66.850	2,385	42,572	65.631	2,794,043				44,957	2,871,091
1987	87.46	44.62	98,375	69.171	2,786	37,153	39.002	1,449,041	13,092	560.64	630,606	53,031	2,178,022
1988	129.48	66.06	145,639	68.958	3,915	32,993	41.271	1,361,654	13,655	468.74	527,237	50,563	2,034,530
1989	141.36	72.12	159,001	57.574	4,937	18,255	73.228	1,336,777	13,480	538.21	605,376	36,672	2,101,155
1990	102.744	52.42	115,566	67.221	3,274	11,630	41.246	479,691	13,955	795.97	895,300	28,859	1,490,557
1991	114.32	58.33	128,587	76.681	3,290	10,070	62.061	624,954	17,232	813.21	914,695	30,592	1,668,236
1992	139.81	71.33	157,258	73.737	4,111	16,304	39.219	639,427	8,939	298.31	335,538	29,354	1,132,222
1993	387.30	197.60	435,638	81.631	5,278	29,861	50.988	1,522,553	30,545	1,191.52	1,340,217	65,684	3,298,407
1994	513.46	261.97	577,535	82.713	6,688	5,638	68.280	384,963	13,410	637.71	717,294	25,736	1,679,791
1995	393.93	200.98	720,219	75.676	9,517	32,499	47.629	1,547,895	10,864	710.27	798,909	52,880	3,067,023
1996	402.03	205.12	760,364	81.934	9,280	21,573	33.697	726,945	22,153	949.22	1,067,682	53,006	2,554,992
1997	381.08	194.43	537,594	85.937	6,256	8,743	54.834	479,414	7,754	250.42	281,671	22,753	1,298,679
1998	267.07	136.26	505,275	74.007	6,827	11,762	35.977	423,161	6,002	280.09	315,044	24,591	1,243,480
1999	113.10	57.70	400,821	74.007	5,416	11,122	48.304	537,237	3,464	117.63	132,310	20,002	1,070,368
2000	191.15	97.53		74.007	0	12,847	16.749	215,174	7,495	216.13	243,102	20,342	458,277

[1] From weighout data sheets; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from weighout data sheets, values for 1998-2000 are taken as the mean of 1986-1997 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] Almost all recreational landings are from the MRFSS survey; [7] In pounds dressed weight; [8] Pelagic dead discards are equal to the sum of dead discards for individual species (Tables 2-8) for 1987-1992, but not for the remaining years because there were unclassified thresher sharks reported in 1993-1995 (not included in Table 4) and other unclassified pelagic sharks in 1996-2000; [9] Whole weight to dressed weight conversion ratio is 1.96.

Table 2. Estimates of commercial and recreational landings and dead discards for blue sharks in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww) [1]	mt (dw) [2]	lb (dw) [3]	av. weight [4]	number [5]	number [6]	av. weight [7]	lb (dw)	number	mt (ww)	lb (dw) [8]	number	lb (dw)
1981						4,925	46.653	229,766				4,925	229,766
1982	0.00	0.00	0		0	0	46.653	-				0	0
1983	0.00	0.00	0		0	14,593	46.653	680,807				14,593	680,807
1984	0.00	0.00	0		0	2,579	46.653	120,318				2,579	120,318
1985	0.00	0.00	0		0	11,621	33.003	383,528				11,621	383,528
1986	0.40	0.20	450	148.500	6	18,898	66.182	1,250,707				18,904	1,251,157
1987	0.00	0.00	0	69.091	0	20,683	47.545	983,373	12,506	526.20	591,868	33,189	1,575,241
1988	0.10	0.05	112	69.091	4	12,235	32.62	399,106	12,934	421.16	473,719	25,173	872,937
1989	0.00	0.00	0	69.091	0	7,419	41.011	304,261	12,525	480.00	539,902	19,944	844,163
1990	0.25	0.13	286	69.091	6	1,745	56.134	97,954	13,141	741.33	833,845	14,892	932,084
1991	0.00	0.00	0	69.091	0	6,643	52.12	346,233	16,562	772.32	868,702	23,205	1,214,936
1992	0.47	0.24	529	67.769	14	5,853	41.191	241,091	7,043	184.39	207,401	12,910	449,021
1993	7.88	4.02	8,860	75.188	85	14,114	53.567	756,045	29,329	1,136.33	1,278,139	43,528	2,043,044
1994	7.82	3.99	8,796	79.960	105	507	46.653	23,653	11,986	572.24	643,653	12,598	676,103
1995	3.61	1.84	3,106	66.557	47	459	46.653	21,414	9,725	618.15	695,293	10,231	719,812
1996	5.40	2.76	17,920	70.819	253	11,224	34.07	382,402	18,996	710.69	799,381	30,473	1,199,703
1997	1.42	0.72	904	52.933	17	4,236	55.74	236,115	6,614	184.61	207,643	10,867	444,662
1998	2.87	1.46	706	69.091	10	6,085	46.653	283,884	5,295	195.25	219,616	11,390	504,206
1999	0.16	0.08	1,111	69.091	16	5,218	46.653	243,435	2,772	98.96	111,310	8,006	355,856
2000	0.61	0.31		69.091	0	6,779	46.653	316,261	6,298	137.19	154,311	13,077	470,571

[1] From weighout data sheets; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from weighout data sheets, values for 1987-1991 and 1998-2000 are taken as the mean of 1986 and 1992-1997 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] Almost all recreational landings are from the MRFSS survey; [7] In pounds dressed weight, values for 1981-1984, 1994-1995, and 1998-2000 are taken as the mean of 1985-1993 and 1996-1997 values, for which n≥5; [8] Whole weight to dressed weight conversion ratio is 1.96.

Table 3. Estimates of commercial and recreational landings and dead discards for shortfin makos in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww) [1]	mt (dw) [2]	lb (dw) [3]	av. weight [4]	number [5]	number [6]	av. weight [7]	lb (dw)	number	mt (ww)	lb (dw) [8]	number	lb (dw)
1981						7,678	56.395	433,001				7,678	433,001
1982	42.12	21.49	47,376		1298	13,522	50.996	689,568				14,820	736,944
1983	6.78	3.46	7,626		225	7,375	52.450	386,815				7,600	394,441
1984	42.46	21.66	47,759		1436	15,474	67.531	1,044,975				16,910	1,092,734
1985	53.24	27.16	59,884		1877	79,912	41.487	3,315,309				81,789	3,375,193
1986	64.76	33.04	72,842	64.936	2,318	20,792	70.107	1,457,665				23,110	1,530,507
1987	77.84	39.71	87,554	65.771	2,592	14,809	35.069	519,337	217	8.72	9,808	17,618	616,699
1988	101.37	51.72	114,021	63.095	3,398	19,998	44.693	893,771	127	5.08	5,714	23,523	1,013,505
1989	124.56	63.55	140,105	55.771	4,608	8,367	90.117	754,009	249	9.01	10,134	13,224	904,248
1990	91.77	46.82	103,223	63.843	3,081	8,509	35.483	301,925	259	10.31	11,593	11,849	416,741
1991	104.87	53.51	117,957	75.502	3,085	3,422	69.020	236,186	245	11.16	12,553	6,752	366,697
1992	125.97	64.27	141,691	71.833	3,782	8,382	33.589	281,543	771	38.41	43,203	12,935	466,437
1993	281.09	143.41	316,164	77.355	4,044	15,034	49.883	749,941	562	24.03	27,029	19,640	1,093,134
1994	324.66	165.64	365,177	76.717	4,623	4,496	79.296	356,515	558	21.45	24,127	9,677	745,818
1995	288.83	147.36	237,736	71.209	3,339	31,042	51.227	1,590,189	446	28.44	31,989	34,827	1,859,914
1996	238.05	121.46	216,120	83.239	2,596	9,397	30.265	284,400	0	0.00	-	11,993	500,520
1997	245.46	125.23	224,362	84.574	2,653	3,025	60.839	184,038	0	0.00	-	5,678	408,400
1998	199.76	101.92	224,421	71.154	3,154	5,633	29.590	166,680	0	0.00	-	8,787	391,101
1999	90.05	45.94	170,860	71.154	2,401	1,383	52.450	72,538	0	0.00	-	3,784	243,398
2000	166.74	85.07		71.154	0	5,563	52.450	291,777	0	0.00		5,563	291,777

[1] From weighout data sheets; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from weighout data sheets, values for 1998-2000 are taken as the mean of 1986-1997 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] Almost all recreational landings are from the MRFSS survey; [7] In pounds dressed weight, values for 1983 and 1999-2000 are taken as the mean of 1981-1982 and 1984-1998 values, for which n≥5; [8] Whole weight to dressed weight conversion ratio is 1.96.

Table 4. Estimates of commercial and recreational landings and dead discards for thresher sharks in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww)[1]	mt (dw)[2]	lb (dw)[3]	av. weight[4]	number[5]	number[6]	av. weight	lb (dw)	number[7]	mt (ww)[7]	lb (dw)[8]	number	lb (dw)
1981						0		-				0	0
1982	3.15	1.607	3,543		53	0		-				53	3,543
1983	9.37	4.781	10,541		146	0		-				146	10,541
1984	6.44	3.286	7,244		95	5,242		-				5,337	7,244
1985	4.05	2.066	4,555		83	607		-				690	4,555
1986	2.94	1.500	3,307	138.615	51	2,805		-				2,856	3,307
1987	8.30	4.235	9,336	112.629	160	1,656		-	369	25.72	28,930	2,185	38,266
1988	26.40	13.469	29,695	125.871	494	122		-	594	42.50	47,804	1,210	77,498
1989	14.25	7.270	16,028	117.930	274	2,448		-	706	49.20	55,340	3,428	71,368
1990	8.95	4.566	10,067	145.966	150	1,368		-	555	44.33	49,862	2,073	59,929
1991	6.31	3.219	7,097	119.897	121	0		-	425	29.73	33,440	546	40,538
1992	10.42	5.316	11,720	109.647	238	2,069		-	471	39.40	44,317	2,778	56,037
1993	36.83	18.793	41,431	123.143	341	0		-	13	0.92	1,035	354	42,466
1994	62.94	32.113	70,796	119.714	546	577		-	38	2.72	3,059	1,161	73,856
1995	60.23	30.732	120,988	99.577	1,215	768		-	0	0.00	-	1,983	120,988
1996	61.76	31.509	87,130	107.650	809	945		-	633	66.37	74,657	2,387	161,787
1997	67.29	34.332	145,253	113.884	1,275	1,472		-	353	39.09	43,966	3,100	189,219
1998	44.07	22.485	102,531	119.544	858	36		-	0	0.00	-	894	102,531
1999	19.24	9.818	96,012	119.544	803	4512		-	0	0.00	-	5,315	96,012
2000	21.13	10.780		119.544	0	505		-	0	0.00		505	0

[1] From weighout data sheets; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from weighout data sheets, values for 1998-2000 are taken as the mean of 1986-1997 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] Almost all recreational landings are from the MRFSS survey and no average weights were available; [7] In 1993-1995 there were some unclassified thresher sharks reported, which are not included here; [8] Whole weight to dressed weight conversion ratio is 1.96.

Table 5. Estimates of commercial and recreational landings and dead discards for longfin makos in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww) [1]	mt (dw) [2]	lb (dw) [3]	av. weight [4]	number [5]	number [6]	av. weight	lb (dw)	number	mt (ww)	lb (dw) [7]	number	lb (dw)
1981								-				0	0
1982	0.11	0.06	124		2			-			-	2	124
1983	0.00	0.00	0		0			-			-	0	0
1984	0.13	0.07	146		5			-			-	5	146
1985	0.55	0.28	619		7			-			-	7	619
1986	0.12	0.06	135	139.679	2	0		-			-	2	135
1987	0.63	0.32	709	103.286	11	0		-	0	0.00	-	11	709
1988	1.41	0.72	1,586	191.462	15	0		-	0	0.00	-	15	1,586
1989	1.00	0.51	1,125	192.889	9	0		-	0	0.00	-	9	1,125
1990	0.65	0.33	731	143.857	11	0		-	0	0.00	-	11	731
1991	0.59	0.30	664	123.143	10	0		-	0	0.00	-	10	664
1992	1.27	0.65	1,428	154.600	19	0		-	419	26.44	29,740	438	31,168
1993	3.09	1.57	3,470	145.158	24	0		-	69	4.69	5,275	93	8,745
1994	8.31	4.24	9,343	144.413	51	0		-	200	10.90	12,260	251	21,603
1995	2.24	1.14	5,659	98.900	57	0		-	184	14.41	16,208	241	21,867
1996	3.04	1.55	11,037	139.905	79	0		-	0	0.00	-	79	11,037
1997	2.02	1.03	7,867	98.857	80	0		-	0	0.00	-	80	7,867
1998	1.96	1.00	4,971	139.679	36	0		-	0	0.00	-	36	4,971
1999	0.97	0.49	4,619	139.679	33	0		-	0	0.00	-	33	4,619
2000	0.06	0.03		139.679	0	0		-	0	0.00		0	0

[1] From weighout data sheets; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from weighout data sheets, values for 1986 and 1998-2000 are taken as the mean of 1987-1997 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] No recreational landings were reported; [7] Whole weight to dressed weight conversion ratio is 1.96.

Table 6. Estimates of commercial and recreational landings and dead discards for oceanic whitetip sharks in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww) [1]	mt (dw) [2]	lb (dw) [3]	av. weight [4]	number [5]	number [6]	av. weight	lb (dw)	number	mt (ww)	lb (dw) [7]	number	lb (dw)
1981						0		-				0	0
1982	0.00	0.00	0		0	0		-				0	0
1983	35.62	18.17	40,065		1248	0		-				1,248	40,065
1984	0.00	0.00	0		0	0		-				0	0
1985	0.02	0.01	22		1	0		-				1	22
1986	0.16	0.08	180	69.600	5	77		-				82	180
1987	0.00	0.00	0	59.349	0	0		-			-	0	0
1988	0.00	0.00	0	59.349	0	0		-			-	0	0
1989	0.30	0.15	337	59.349	7	20		-			-	27	337
1990	0.10	0.05	112	59.349	2	0		-			-	2	112
1991	0.11	0.06	124	58.000	4	5		-			-	9	124
1992	0.91	0.46	1,024	67.786	30	0		-	206	7.53	8,470	236	9,493
1993	7.83	3.99	8,803	62.297	141	0		-	305	3.5	3,937	446	12,740
1994	3.28	1.67	3,691	54.925	68	0		-	366	4.38	4,927	434	8,617
1995	3.40	1.73	782	65.308	12	2		-	197	6.47	7,277	211	8,059
1996	7.77	3.96	1,289	56.893	23	0		-			-	23	1,289
1997	7.94	4.05	2,764	39.986	69	0		-			-	69	2,764
1998	5.89	3.01	22,049	59.349	372	0		-			-	372	22,049
1999	1.06	0.54	698	59.349	12	0		-			-	12	698
2000	1.55	0.79		59.349	0	0		-				0	0

[1] From weighout data sheets; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from weighout data sheets, values for 1987-1990 and 1998-2000 are taken as the mean of 1986 and 1991-1997 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] Almost no recreational landings were reported and no average weights were available; [7] Whole weight to dressed weight conversion ratio is 1.96.

Table 7. Estimates of commercial and recreational landings and dead discards for porbeagles in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww) [1]	mt (dw) [2]	lb (dw) [3]	av. weight [4]	number [5]	number [6]	av. weight	lb (dw)	number	mt (ww)	lb (dw) [7]	number	lb (dw)
1981								-				0	0
1982	0.03	0.01	34		1	0		-			-	1	34
1983	0.12	0.06	135		8	0		-			-	8	135
1984	0.09	0.05	101		2	0		-			-	2	101
1985	0.13	0.07	146		1	0		-			-	1	146
1986	0.10	0.06	135	84.98	3	0		-			-	3	135
1987	0.69	0.35	776	114.00	23	0		-	0	0.00	-	23	776
1988	0.2	0.10	225	84.98	4	0		-	0	0.00	-	4	225
1989	1.25	0.64	1,406	106.50	39	0		-	0	0.00	-	39	1,406
1990	1.02	0.52	1,147	86.44	24	0		-	0	0.00	-	24	1,147
1991	2.44	1.24	2,745	69.96	70	0		-	0	0.00	-	70	2,745
1992	0.77	0.39	866	51.96	28	0		-	29	2.14	2,407	57	3,273
1993	50.59	25.81	56,909	90.13	643	0		-	0	0.00	-	643	56,909
1994	106.36	54.27	119,635	94.57	1,294	53		-	23	1.23	1,383	1,370	121,018
1995	35.52	18.12	8,011	84.89	94	0		-	0	0.00	-	94	8,011
1996	78.05	39.82	14,194	70.02	203	0		-	0	0.00	-	203	14,194
1997	55.61	28.37	4,222	81.36	52	0		-	0	0.00	-	52	4,222
1998	12.52	6.39	19,795	84.98	233	0		-	0	0.00	-	233	19,795
1999	1.63	0.83	5,362	84.98	63	0		-	0	0.00	-	63	5,362
2000	1.06	0.54		84.98	0	0		-	0	0.00	-	0	0

[1] From weighout data sheets; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from weighout data sheets, values for 1986, 1988, and 1998-2000 are taken as the mean of 1987 and 1989-1997 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] Almost no recreational landings were reported and no average weights were available; [7] Whole weight to dressed weight conversion ratio is 1.96.

Table 8. Estimates of commercial and recreational landings and dead discards for bigeye thresher sharks in the U.S. Atlantic, Gulf of Mexico, and Caribbean.

Year	Commercial					Recreational			Discards			Total	
	mt (ww)[1]	mt (dw)[2]	lb (dw)[3]	av. weight[4]	number[5]	number[6]	av. weight	lb (dw)	number	mt (ww)	lb (dw)[7]	number	lb (dw)
1981						0		-				0	0
1982	0.00	0.00	0		0	0		-			-	0	0
1983	0.00	0.00	0		0	0		-			-	0	0
1984	0.00	0.00	0		0	0		-			-	0	0
1985	0.00	0.00	0		0	0		-			-	0	0
1986	0.00	0.00	0		0	0		-			-	0	0
1987	0.00	0.00	0		0	0		-	0	0.00	-	0	0
1988	0.00	0.00	0		0	634		-	0	0.00	-	634	0
1989	0.00	0.00	0		0	0		-	0	0.00	-	0	0
1990	0.00	0.00	0		0	0		-	0	0.00	-	0	0
1991	0.00	0.00	0		0	0		-	0	0.00	-	0	0
1992	0.00	0.00	0	100.216	0	0		-	0	0.00	-	0	0
1993	0.00	0.00	0	102.125	0	0		-	242	20.24	22,766	242	22,766
1994	0.00	0.00	0	152.430	0	0		-	147	18.21	20,483	147	20,483
1995	0.00	0.00	1,497	57.142	26	0		-	274	38.82	43,665	300	45,162
1996	0.00	0.00	8,164	98.570	83	0		-	0	0.00	-	83	8,164
1997	0.00	0.00	5,308	82.433	64	0		-	0	0.00	-	64	5,308
1998	0.00	0.00	1,403	99.256	14	0		-	0	0.00	-	14	1,403
1999	0.00	0.00	17,759	109.557	162	0		-	0	0.00	-	162	17,759
2000	0.00	0.00		100.216	0	0		-	0	0.00		0	0

[1] No landings from weighout data sheets reported; [2] Whole weight to dressed weight conversion ratio is 1.96; [3] 1982-1994 data are from weighout data sheets, 1995-1999 data are from the southeast quota monitoring program and southeast and northeast general canvass, data for 2000 were not yet available; [4] In pounds dressed weight from the SEFSC pelagic observer program, values for 1992 and 2000 are taken as the mean of 1993-1999 values; [5] 1982-1994 data are taken directly from weighout data sheets, 1995-2000 data obtained by dividing values in fourth column (lb dw) by those in fifth column (av. weight); [6] Almost no recreational landings were reported and no average weights were available; [7] Whole weight to dressed weight conversion ratio is 1.96.

Table 9. Trends in catch rates of pelagic sharks. Slopes and standard errors (SE) of the slopes were obtained from linear regressions of relative catch rates on year. Slopes significantly different from 0 are denoted as * (5% level), ** (1% level), and *** (0.1% level).

Series	Sample size	Years	Slope	SE
Blue shark				
Japanese observer	11	1978-1988	-0.1150*	0.0440
LPL[1]	14	1986-1999	-0.0968***	0.0188
LPS[1]	13	1986-1998	0.1747**	0.0394
PLLOP[1]	9	1992-2000	0.0997	0.0764
Mako sharks				
Japanese observer	11	1978-1988	-0.1654**	0.0418
LPL[1]	14	1986-1999	-0.1275***	0.0188
Weighout[1]	9	1985-1993	-0.0199	0.0312
LPS[1]	13	1986-1998	0.0756	0.0452
PLLOP	9	1992-2000	-0.1691*	0.0571
Thresher sharks				
LPL[1]	14	1986-1999	-0.1509**	0.0358
Weighout[1]	9	1985-1993	0.0752	0.1164
Oceanic whitetip				
LPL	8	1992-1999	0.0252	0.0427
PLLOP[1]	9	1992-2000	-0.1769**	0.0407
Porbeagle				
LPL[1]	8	1992-1999	-0.5553	0.3963

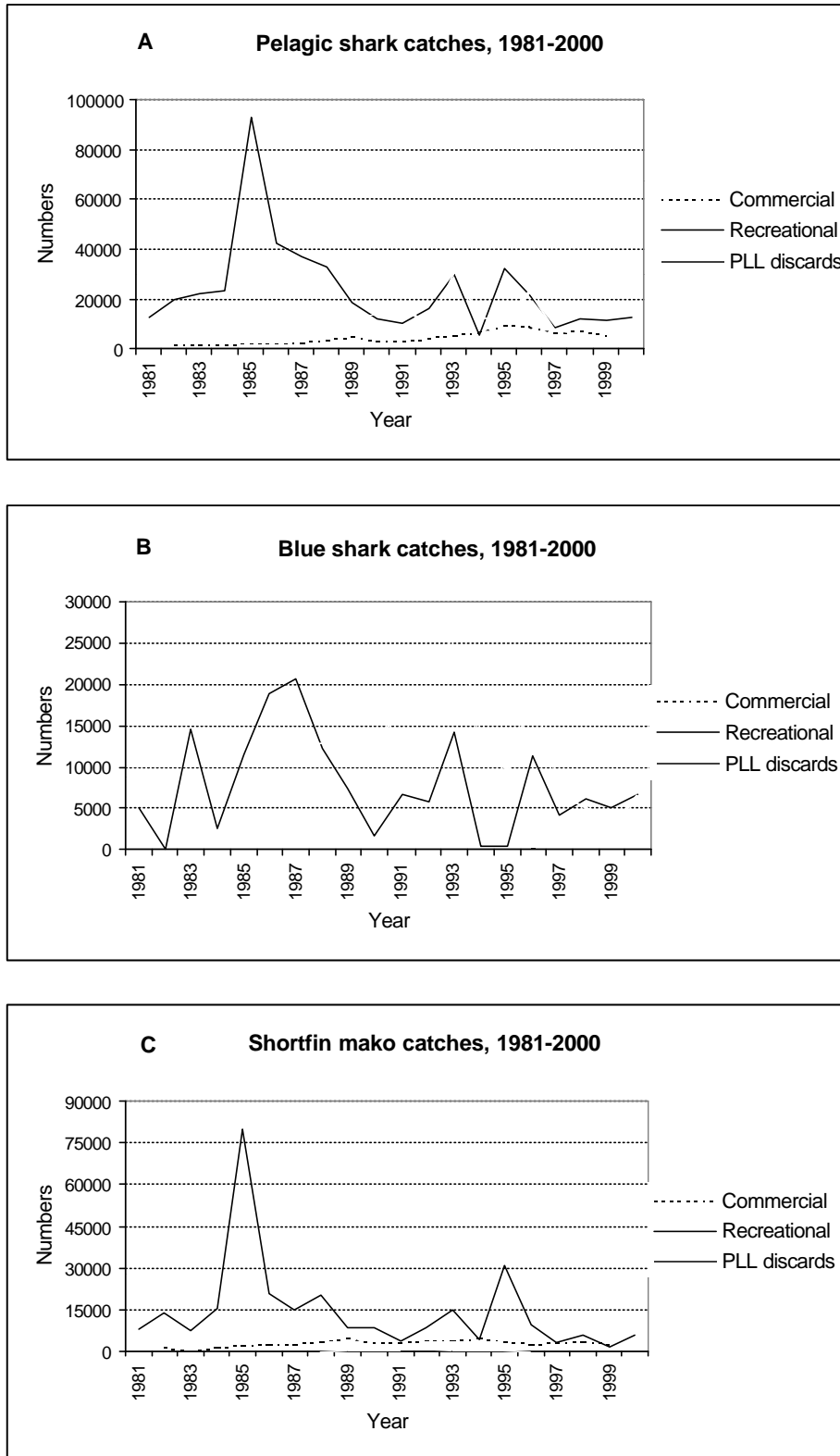[1] Indicates that the dependent variable (catch rate) was log-transformed.

Figure 1. Estimated annual catches (in numbers) of pelagic shark species in the northwestern Atlantic, Gulf of Mexico, and Caribbean: (A) pelagic shark species combined; (B) blue shark; and (C) shortfin mako.
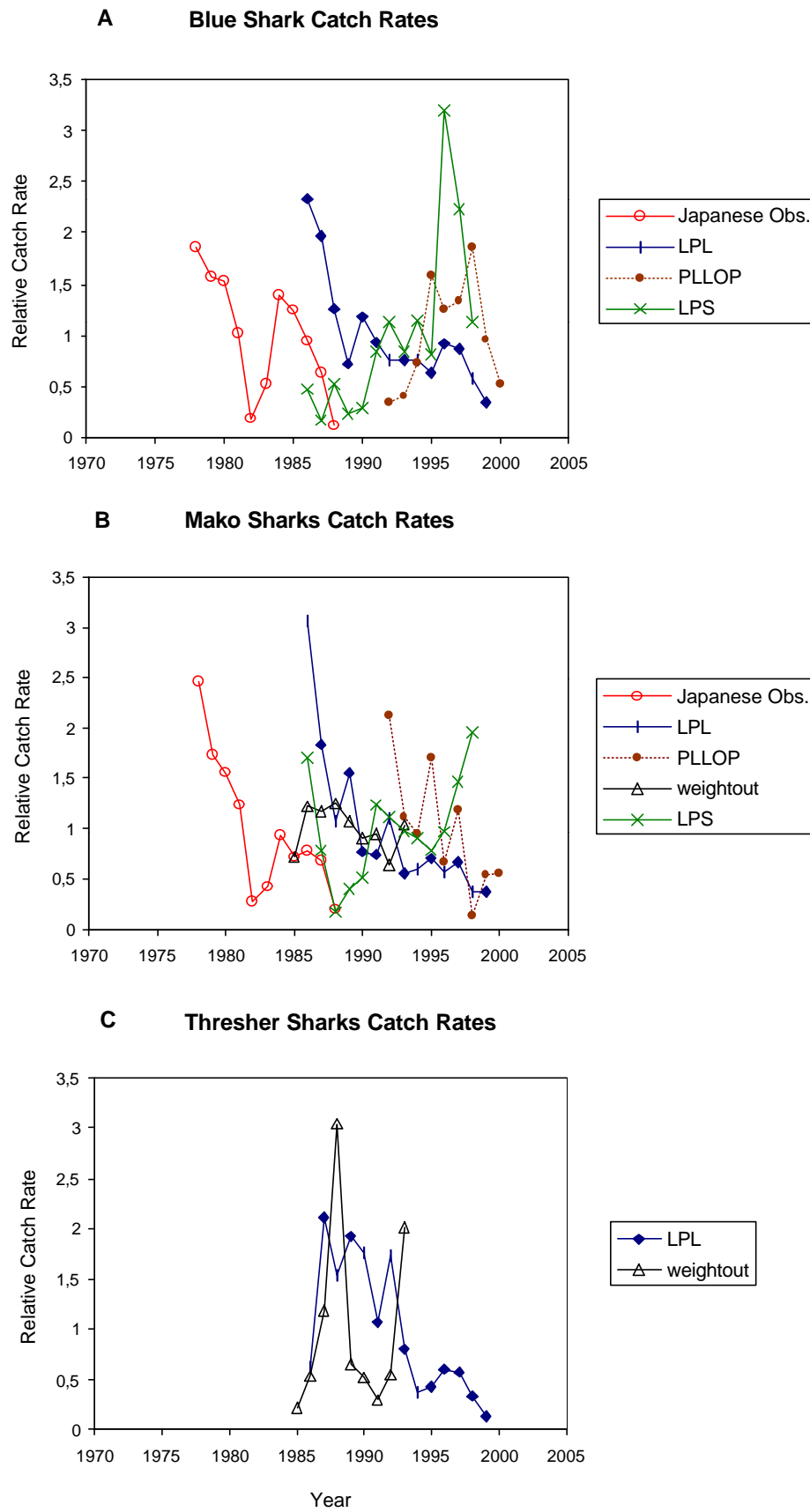
A   **Blue Shark Catch Rates**

B   **Mako Sharks Catch Rates**

C   **Thresher Sharks Catch Rates**

Figure 2. Scaled standardized catch rates of pelagic shark species from several sources: (A) blue shark; (B) mako sharks; (C) thresher sharks.
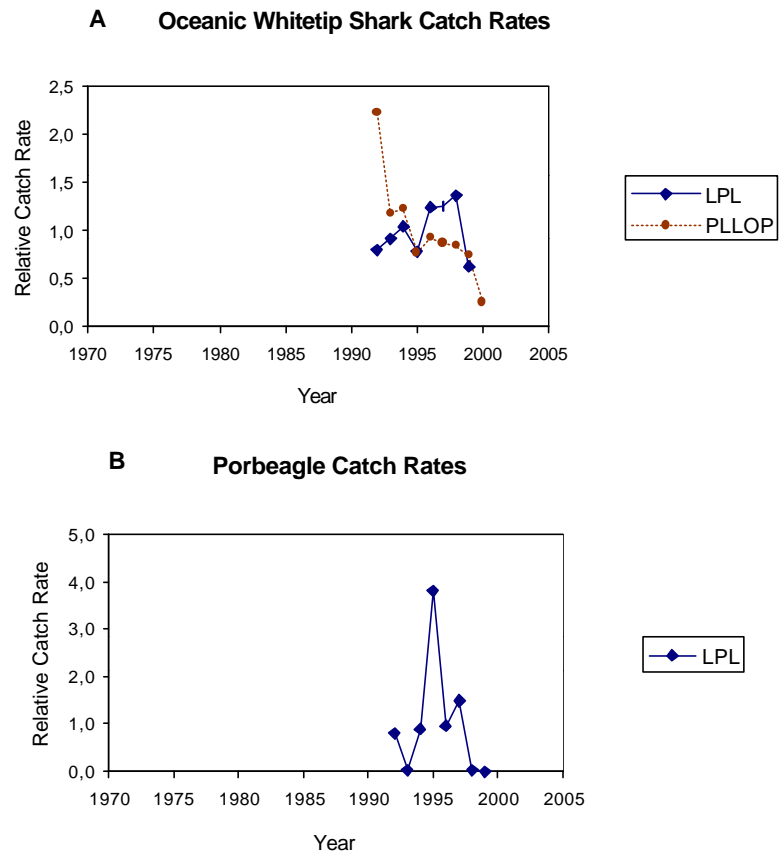
Figure 3. Scaled standardized catch rates of pelagic shark species from several sources: (A) oceanic whitetip shark; (B) porbeagle.
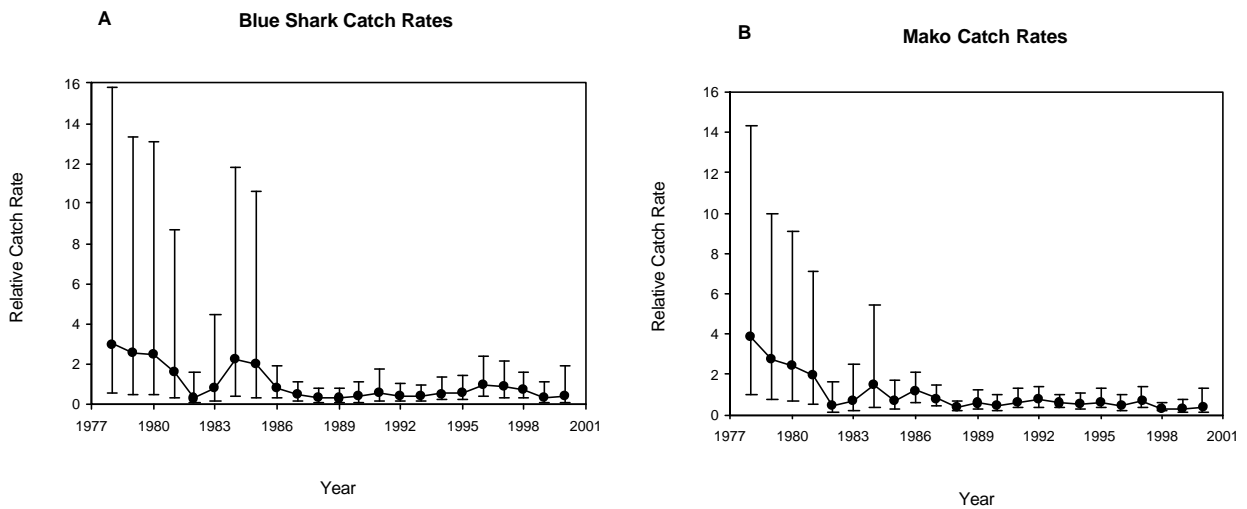

Figure 4. Scaled catch rates of (A) blue shark and (B) makos standardized through a Generalized Linear Model fit to all time series available for each. Vertical bars are approximate 95% confidence limits.